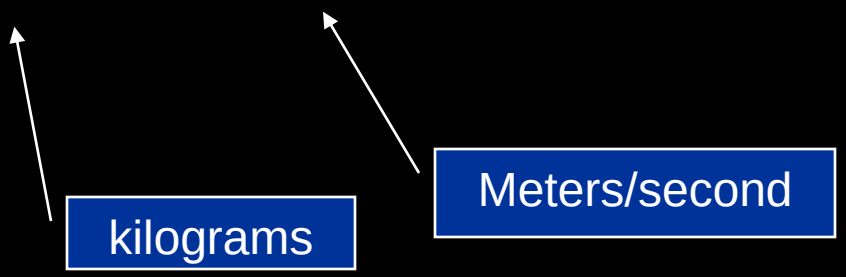
Ch 2 Momentum

Physical Science 115

Why are the engines of a supertanker normally cut off 25 km from port?

Momentum

- Momentum is inertia in motion.
- Momentum = mass x velocity



- Example: How much momentum does a 2 kg object have that is moving at 6m/s?

  momentum=(2kg)(6m/s) = 12kg m/s

The bullet has large momentum because it has large speed.

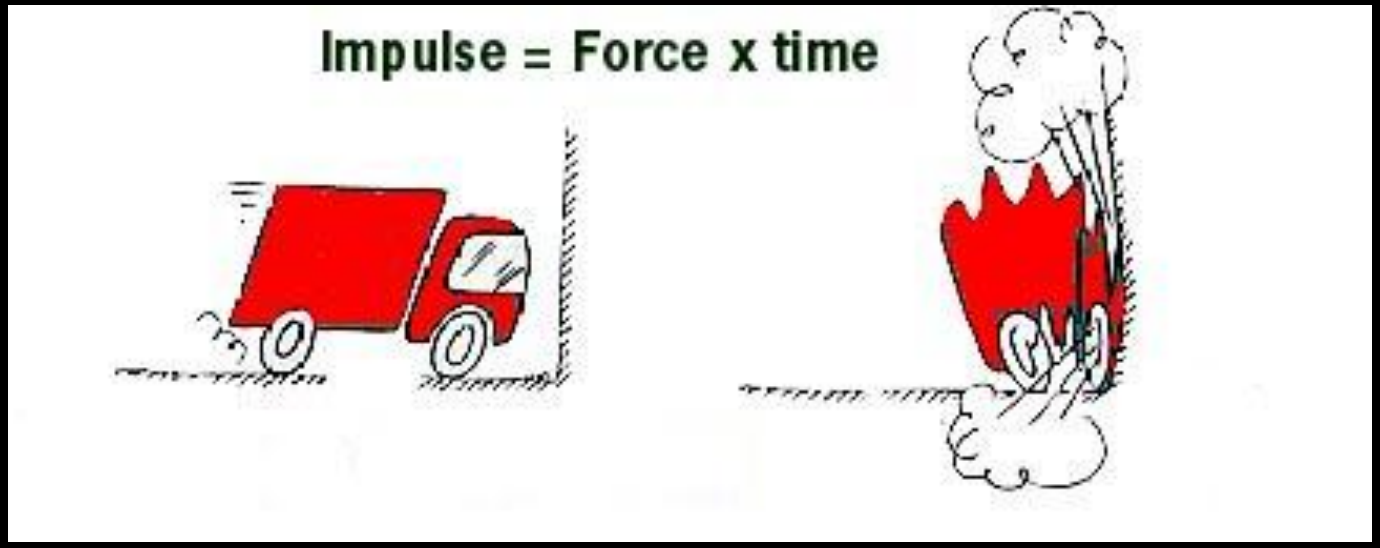
The supertanker has large momentum because it has large mass.

Impulse: How do you change the momentum of something?

- Apply a force.
- But the time over which the force acts, is also important.

(If trying to get a broken down car moving, and you push tremendously but only for a split-second, it won't move. You need to exert the force for a longer time.)

Formula for Impulse



Example: Wall exerts a force of 10,000 N. The contact time is .001 s. What is the impulse?

Impulse = F t

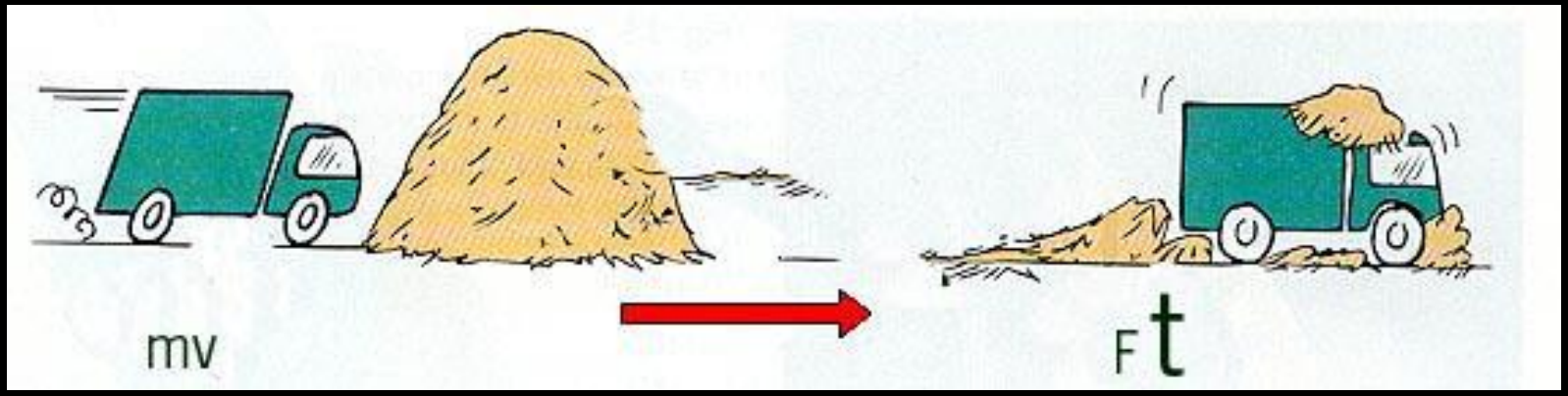
= 10 N-s

Impulse Changes Momentum

Impulse = The change in momentum

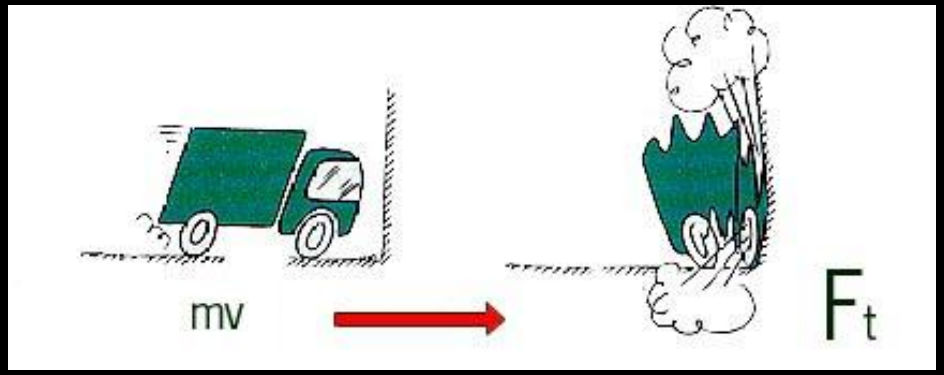
Decreasing Momentum over a long time

For the same change in momentum (moving then stopped), If the time over which a truck stops is large, the force will be relatively small.

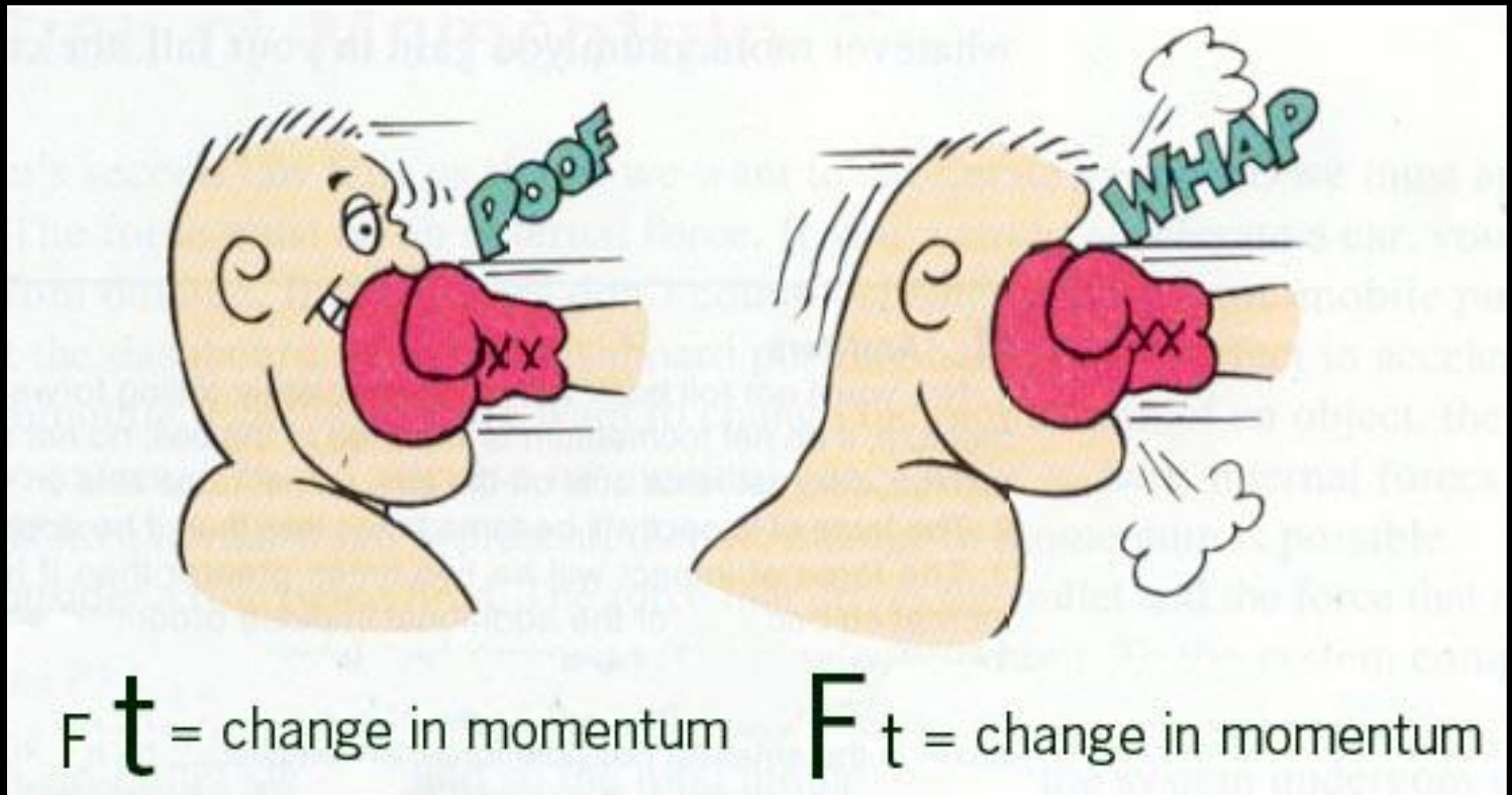


Decreasing Momentum over a short time.

If the time over which a truck stops is small, the force will be relatively large.



Spreading impulse out over a longer time means that the force will be less; either way, the change in momentum of the boxing glove, fist, and arm will be the same.



Check Questions

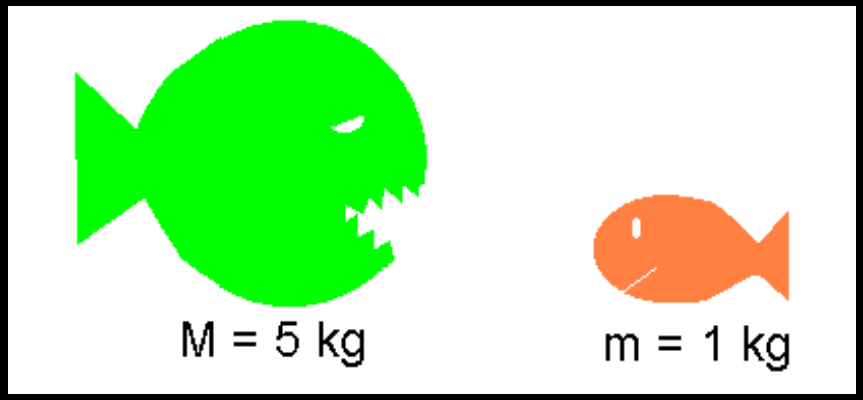
- A garbage truck and a mini car have a head-on collision.
- Which vehicle experiences the greater force of impact?
- Which experiences the greater impulse?
- Which experiences the greater momentum change?
- Which experiences the greater acceleration?

Conservation of Momentum

The total momentum of an isolated system of objects is conserved regardless of the nature of the forces between the objects.

Total Momentum Before Collision	=	Total Momentum After Collision

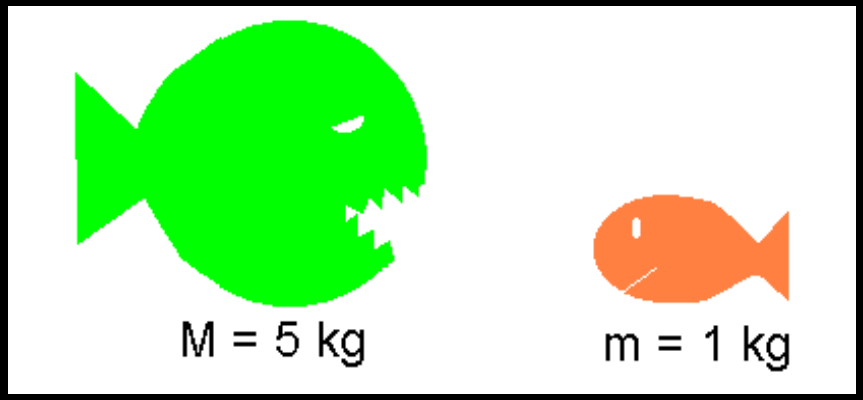
Examples: Conservation of Momentum



1. Consider a fish that swims towards and swallows a small fish at rest. If the large fish swims 1 m/s towards the small fish, what is the velocity of the larger fish immediately after lunch?

2. Suppose the small fish is not at rest, but swims toward the left at a velocity of 4 m/s. What is the velocity of the larger fish immediately after lunch?

Examples: Conservation of Momentum



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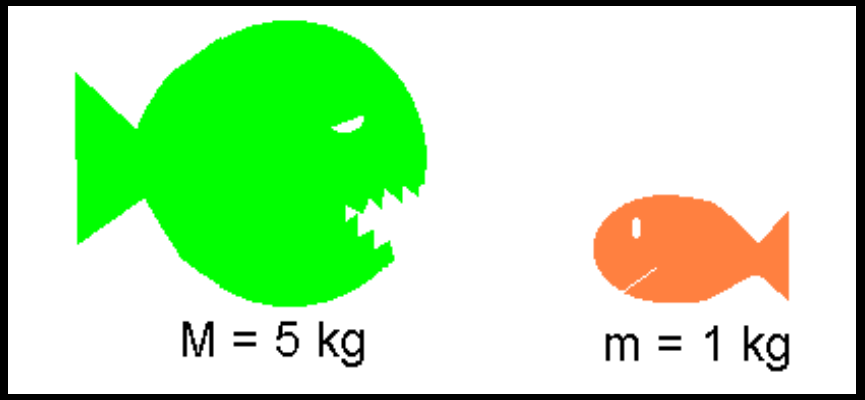


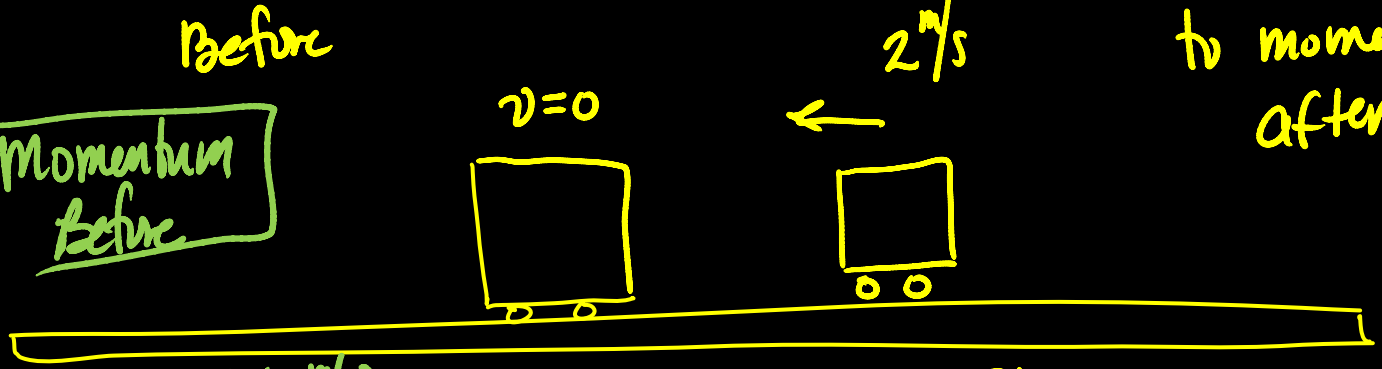
2. Suppose the small fish is not at rest, but swims toward the left at a velocity of 4 m/s. What is the velocity of the larger fish immediately after lunch?

Example 3

Is momentum Before equal to momentum after??

Before

Momentum Before



$= (0.5\text{kg})(2\text{m/s})$

$= 1\ \text{kg}\cdot\frac{\text{m}}{\text{s}}$

Momentum After

$(1.0\text{kg})(1.5\text{m/s}) + (0.5\text{kg})(-1\frac{\text{m}}{\text{s}})$

$1\ \text{kg}\cdot\frac{\text{m}}{\text{s}}$